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THE ASSISTANT COMMISSIONER FOR PATENTS
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[ ] ATTN: BOX PATENT APPLICATION
[X] ATTN: BOX PCT

[X] THIS IS THE NATIONAL STAGE OF PCT/EP99/01014 FILED February 10, 1999

Sir:

Transmitted herewith for filing is the [X] Utility [ ] Design patent application of:

Inventor/Application Identifier: **Johann Michael KOEHLER et al.**

For: **MINIATURIZED TEMPERATURE-ZONE FLOW REACTOR**

Enclosed are:

[X] 2 sheets of drawings ([X] formal [ ] informal size A4).
[X] 16 pages of specification, including claims and abstract.
[X] 18 total pages

[X] Combined Declaration/Power of Attorney
- [X] Newly executed
- [ ] Copy from prior application
- [ ] Inventors deleted; see attached statement
- [ ] Inventor Information Sheet

[ ] Incorporation By Reference. The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein

[ ] Sequence Listing
- [ ] Computer Readable Copy
- [ ] Paper copy
- [ ] The undersigned hereby affirms that the content of the paper and computer readable copies of the Sequence Listing are the same.

[ ] Cancel in this application original claims ________ of the prior application before calculating the filing fee.

CLAIMS FILED

For	Number Filed	Number Extra		Rate	Basic Fee $840.00
Total Claims	11	0	(over 20)	x $18.00	
Independent Claims	1	0	(over 3)	x $78.00	
[ ] Multiple Dependent Claim				$260.00	
[ ] Reduce by 50% for Small Entity					
[ ] Foreign Language Filing Fee				$130.00	
				TOTAL FILING FEE	$840.00

[X] Please charge Deposit Account No. 10-1250 in the amount of $840.00.
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[X] Return Receipt Postcard

[X] Preliminary Amendment

[X] Assignment to **Institut fuer Physikalische Hochtechnologie e.V.**

[ ] Assignment is of record in prior application Serial No. ______.
[X] Assignment Recordation Form Cover Sheet.
[X] Charge $40.00 to Deposit Account No. 10-1250 for recording Assignment.

[X] Information Disclosure Statement and/or Information Disclosure Citation

[ ] English translation

[ ] Small Entity Declaration

[ ] filed herewith

[ ] filed in prior application and status is still proper and desired.

[ ] Applicant hereby claims the benefit of the filing date of the following provisional application(s) under the provisions of 35 USC 119.

[X] Applicant hereby claims the benefit of the filing date of the following applications under the provisions of 35 USC 119 of which certified copies [ ] will follow [ ] are enclosed [X] have been filed in the International Bureau [ ] were filed in prior application No. ______.

German Patent Application No. 198 05 350.9, filed February 11, 1998.

[ ] This is a [ ] Continuation [ ] Divisional [ ] Continuation-in-Part of prior application Serial No. ______.

[ ] Amend the specification by inserting before the first line the sentence:
--This is a [ ] continuation, [ ] division, [ ] continuation-in-part, of application Serial No. , filed . --

JORDAN AND HAMBURG LLP

By ______
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Attorney for Applicants

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F-6579

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Johann Michael KOEHLER et al.
Serial No.	:	(U.S. National Stage of PCT/EP99/01014 filed February 10, 1999)
Filed	:	(Concurrently herewith)
For	:	MINIATURIZED TEMPERATURE-ZONE FLOW REACTOR

Assistant Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Preliminary to examination, please amend this application as follows:

IN THE CLAIMS:

Claim 3, lines 1 and 2, change "claims 1 and 2" to --claim 1 or 2--.

Claim 5, lines 1 and 2, change "claims 1 and 2" to --claim 1 or 2--.

REMARKS

This Preliminary Amendment eliminates informalities in the multiple dependencies of certain claims.

Respectfully submitted,

JORDAN AND HAMBURG LLP

By

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MINIATURIZED TEMPERATURE-ZONE FLOW REAKTOR

BACKGROUND OF THE INVENTION

The invention relates to a miniaturized temperature-zone flow reactor used for thermally controlled biochemical and molecular-biologic processes, respectively, in particular for the method of the so-called polymerase chain reaction, referred to as PCR in the following, in which definite sequences out of a mixture of DNA-sequences are amplified.

When carrying out thermally controlled biochemical and molecular-biologic processes, respectively, very often different temperatures are required to be applied to the processing steps. Such an applying of changing temperatures are of particular importance with the so-called PCR.
The method of PCR has been developed in the recent years for amplifying definite DNA-sequences, and its principles have been specified by Darnell, J.; Lodish, H.; Baltimore, D. in "Molekular Zellbiologie, Walter de Gruyter, Berlin-New York 1994, p. 256/257". It is an essential, inter alia, with said method that mixtures of DNA-sequences are subjected to a definite changing temperature treatment. Thereby stationary sample treatment equipment is used, in which the respective samples are filled into sample chambers and are then periodically subjected to a heat-cold temperature cyclic treatment in the course of which, depending on the definitely pre-set primers, the

desired DNA-sequences are amplified. In this respect, the effectivity of the sample chambers known up to now is considered as not being sufficient. For this reason there has recently been proposed a miniaturized sample chamber (Northrup et al, DNA Amplification with microfabricated reaction chamber, 7[th] International Conference on Solid State Sensors and Actuators, Proc. Transducers 1993, p. 924-26), which permits a four times faster amplification of the desired DNA-sequences compared to the prior arrangements. This sample chamber, which can take up to 50µl sample fluid, consists of a structurized silicon cell having a longitudinal extension in an order of size of 10 mm which is closed, in a sample affecting direction, by a thin membrane, to which the corresponding temperature is applied by way of a miniaturized heating element. Also with this device the DNA-sequences to be amplified are inserted via micro-channels into the chamber, then they are subjected to a polymerase chain reaction, and subsequently removed. In spite of the advantages obtained by this device, it involves substantially the disadvantage that also this sample chamber has to be heated and cooled as a whole which only permits limited rates of temperature changes. Particularly, when further reducing the size of the sample, the parasitic heat capacity of the sample chamber and that of a necessary temper block, if any, becomes more weighty compared to the sample fluid, so that the possible high temperature cycle rates which are attainable, in principle, with small liquid volumes cannot be obtained, whereby the effectivity of the method is comparatively low. Moreover, a comparatively expensive control system is necessary to obtain each time a constant temperature

schedule for a same fluid, and the heating and cooling power, respectively, provided being substantially consumed in the components surrounding the sample fluid rather than in the sample fluid.

Furthermore, there is known from US-PS 5,270,183 a thermo-cycler operating on the flow principle in which the sample fluid to be amplified is passed through a pipe that sequentially is once or multiply wound around a plurality of cylinders which are kept at different temperatures. Such an embodiment on principle permits an amplification of comparatively small amounts of samples down to about 25µl. The manipulation of such a device, however, is rather impracticable and requires a high skill from the producers of such devices so that they are completely unsuited for a serial production.

A flow thermo-cycler described in WO96/10456, comes nearest to the present invention, in which structurizing technologies known from the so-called micro-system technology are used to provide a sample receiving chamber. This sample receiving chamber permits a dynamic sample treatment of even very small amounts of, partially, very expensive substances. The achievement of this proposed solution is that the sample partial volumes are subjected to a homogeneous temperature throughput in respectively provided heating and cooling zones, also resulting in an increase of the output with respect to the samples to be amplified. Furthermore, and due to the design depending omission of the heating and cooling procedures for the wall materials and the severe minimizing of the parasitic heat capacities and heat influences, not only the required expenditures for the control are

considerably lower, but also the entire cycle of the process is substantially time-reduced. Thereby only as much heating and cooling power has to be fed in as can be transported in the stream of the sample fluid. Additionally, the embodiment of the thermo-cycler described in WO 96/10456 not only permits a continuous process control, but also a serial operation in which different substances can be sequentially introduced into the thermocycler without the danger of an interfering mixing with the sample which is still in the device. This solution, however, is disadvantageous because, on the one hand, there is required a very precise structurizing procedure for manufacturing the membranes provided therein, on the other hand, and due to the set-up of the device described there, the retention time of the sample fluid in the cooling zone ranges is undesiredly high, at least at partial passages, what can lead to the formation of undesired by-products when carrying out PCR.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a miniaturized temperature-zone flow reactor that permits to perform thermally controlled biochemical and molecular-biological processes, respectively, in particular the method of the polymerase chain reaction, more effectively than the prior art.

The object is realized by the features of the first patent claim. Advantageous embodiments are covered by the dependent claims.

Due to the present invention there is realized a cyclic heating and cooling of solutions to different temperature stages in a continuos flow in a very narrow space (in the micrometer range), in order to enable carrying out three reactions, for example, denaturation, annealing and extension to DNS in a sample and, in particular, in several different samples. The sample, respectively, the samples is/are repeatedly transported by a carrier medium in sequential sections through a closed flow path, whereby the sequence and the identical treatment of the sample/s is kept to. In the course thereof, different samples can be successively injected without mixing up with one another and subsequently can be placed in an orderly arrangement in the sample chambers, which can also take place in a parallel arrangement by way of the proposed device.

The invention provides for three micro-structurized chips including channels, the chips consist of a material of good heat conduction in order to arrange a poorly heat conducting connection chip in such a way that at least one closed flow path is formed through all chips. Each of the micro-chips is subjected to a preselectable temperature, which is differing from a respective other one. The inlet openings and the outlet openings of the chips of good heat conduction are captured by the passage openings of the connecting chip in such a way that the sample fluid is permitted to arrive from A to B to C and again to A to B to C, whereby this process can be repeated n-times with n being the number of the channel sections provided in the entry chip (A) and the exit chip (B). The chips kept to the respectively desired temperature

are thereby alternatingly arranged around the connecting chip, so that the different temperature zones are thermally insulated from one another. Within each of the chips of an equal temperature zone the higher heat conductivity of the same leads to a homogeneous temperature distribution of the fluids passing the chips. Furthermore, heater structures and sensor structures are integrated by thin-film technology in the chip. An external cooling can be restricted to the coldest zone. To this end, for example, a cooling unit provided with, for example, Peltier elements that can be designed in thin-film technique can be provided on the surface of the coldest chip (B). Alternatively, also a cooling by an air stream is feasible.

Furthermore, the cooled chip (B) is provided with return channels, the cross-section of which being for example, designed so small that the time of stay of the sample is minimized during the return of chip C to chip A when in chip B. Hence, the time will not be sufficient to raise the temperature of the sample, when being returned to the chip A, to the temperature of the chip B; the sample, to a large extent, remains at the temperature of the chip C. The return channels can be additionally thermally insulated from the chip B.

The use of an optically transparent material for the connecting chip, for example, pyrex glass, permits an optical in situ detection of reactants in the sample by way of a fluorescence detection of an added dyestuff, which is of particular interest for purposes of analysis.

According to the inventional miniaturized temperature-zone flow reactor, the single samples are sequentially injected as drops into a continuous carrier fluid stream which is pumped through the

miniaturized temperature-zone flow reactor. The carrier fluid was so selected that the carrier fluid does not mix with the sample fluid, hence different samples can be processed in sequence. The serial delivery of the sample fluid can be transferred into a parallel two-dimensional array, for example, into a nano-titer plate or into an electrophoresis gel in that the proposed temperature-zone flow reactor is suspended to an x,y-displacement unit. By that unit, the reactor is moved on to a next chamber after a preceding one has been filled with a sample drop. The exit of a drop can be detected by the refraction of a light beam in the sample drop located in the carrier fluid by way of a photometer unit. When there is provided a plurality of flow paths separated from one another on the proposed temperature-zone flow reactor, or when there is operated a plurality of side by side miniaturized temperature-zone flow reactors in the way described above, the mentioned serial transfer of the samples into a parallel array can be realized in a very efficient manner.

DETAILED DESCRIPTION OF THE INVENTION

In order that the invention may be more readily understood reference is made to the accompanying drawings which illustrate diagrammatically and by way of example one schematical embodiment thereof. There is shown in:

Fig. 1 an explosive view of an inventional embodiment of a miniaturized temperature-zone flow reactor, and

Fig. 2 a signal of a photometer at the exit of the miniaturized temperature-zone flow reactor signifying that there is no mixing up of the single sample ranges during the flow passage.

In Fig. 1 a miniaturized temperature-zone flow reactor is shown in an explosive view. For the sake of simplicity, only one closed flow path is shown in the example, the course of which will be described in the following. To begin with, there is provided a first substrate chip A which, in the example, has the external dimensions (length, width, thickness) of (8 x 13 x 0.5)mm and into one side of which channels are inserted that will have a length of 9 mm, a width of 0.536 mm and a depth of 0.380 mm. In the present example, the entire single channel section is to be understood by the here designated length. Said channel section lies, for example, between an inlet opening az2 and an associated outlet opening aa2, so that this channel section can take a volume of 0.9µl in the present example. Furthermore, a third substrate chip C is provided which, in the example, has the external dimensions (length, width, thickness) of (14 x 13 x 0.5)mm andinto one side of which channels are inserted that will have a length of 22 mm, a width of 0.536 mm and a depth of 0.380 mm, so that this single channel section is adapted to take a volume of 2.26µl. With respect to the size here to be understood as length, the same is true as specified with respect to the first substrate chip A. Both mentioned substrate chips A, C are made of a good heat conducting material, silicon in the example, and are captured by heating elements H which are provided on the

entire face of that side which is opposing the opened channel sides. A temperature which can be controlled and varied, is applied to said heating means. In the example, the heating elements H are formed by thin-layer heating elements that are of meander shape and directly deposited on the substrate chips. Furthermore, thin-layer temperature sensors F are integrated into said substrates, said sensors being adapted to control each respectively set temperature.

The inlet openings and the outlet openings az1...aa4 of the first substrate chip A and the inlet openings and the outlet openings cz1...ca4 of the third substrate chip C are, in a spaced apart relation, arranged, side by side, on one side of the respective substrate chip, on a section of the latter, substantially along a line. They are via that surface, which is opposite to the heating means H, deposited upon a first face V1 of a connecting chip V above and connected to the latter. The connection is obtained by anodic bonding in such a manner that said inlet openings and said outlet openings are captured by passage openings Vd which are provided on the connecting chip V. The connecting chip V, which is of poor heat conductivity, is a pyrex-glass chip of 1.1 mm thickness used in the present example.

The rear side connection of the partial paths A1...An and of the partial paths C1...Cn is established by a second substrate chip B that is bonded to the second face V2 of the connecting chip V. A silicon chip with the dimensions (12 x 10 x 0.5) mm is used for the second substrate chip B in the present example, into which longitudinally extending channels are inserted of a length of 9 mm, a width of 0.536 mm, and a depth of 0.38mm. These n channels; four in the example:

B1...B4; receive the respective running flow from A to C. Furthermore, n-1 channels, three in the example: BB1...BB3; are respectively provided in-between said channels B1...B4 which take over the reflux from C to A. The return channels are so embodied that they are initially formed by indentations having a length of 9 mm, a width of 0.26 mm and a depth of 0.184 mm so that they are capable of taking a volume of 0.2µl, whereas the forward conducting channels B1...B4 take a volume of 0.9µl. Furthermore, it is advantageous within the scope of the invention to provide the return channels BB1...BB3 of the substrate chip B with a thermally insulating lining relative to the wall material of the substrate chip B. This can be carried out in the assembled state of the temperature-zone flow reactor by passing through a polymer, which forms deposits on the wall. Anyhow, the return channels are to be given a reduced cross-section in such a way, that the speed of flow through the return channels (BB1...BBn-1) is at least increased by the threefold relative to that through the channels (B1...Bn). At a passage speed of flow of 1µl/min and at a correspondingly adapted dimensioning of the channel sections within the respective substrate chips, the separation, which is described in the present example, of the one closed flow path into three partial paths A1...A4, B1...B4, BB1...BB3, and C1...C4 results in a retention time for the single samples in the respective channel sections of the substrate chips A, B, C and, thus, in affecting times, also with respect to the corresponding preselected temperatures per passage through the respective partial section, as follows: zone A = 55 sec., zone B = 55 sec. in the forward flow channel, and zone B = 14 sec. in the return

channel of zone C = 140 sec.. Since the speed of flow is considerably increased in the return channels BB1...BB3 and the channels, as specified above, are additionally thermally insulated preferably relative to the material of the substrate chip B, the sample temperature in the return flow will be reduced only insignificantly relative to the temperature it took in the section C. Otherwise, the substrate chip B is kept to the required temperature by an external cooling obtained in that it is brought into contact with a cooling unit K or by depositing a Peltier element in thin-layer technique. Alternatively, a cooling in an air-stream is feasible.

Due to the fact that the connecting chip (V) is formed of an optically transparent material, for example, pyrex glass, and that, according to the arrangement of the substrate chips A, C, a free access remains between said substrate chips, there is a chance of an optical in situ detection of the reactants in the sample by way of a fluorescence detection of an added dye-stuff, what is of particular advantage for the purpose of analysis.

In order to perform a PCR, the three temperature zones are so designed in the example that they allow the performing of the denaturation of a double-stranded DNS in the range of the substrate chip A, the attaching of primers to an single-stranded DNS (annealing) in the range of the substrate chip B, and a primer extension by way of TAQ-polymerase in the range of the substrate chip C. The temperatures measured in the present example are: zone A: 95° C; zone B: 55° C; zone C: 72° C. The temperatures in the zones can be kept constant within 1°C by providing a connection to an external

proportional controller. The carrier fluid of the embodiment described passes four times each of the mentioned zones. Furthermore, the first inlet path formed by the partial path az1 to aa1 in the first substrate chip A and the last outlet path formed by the partial path cz4 to ca4 in the third substrate chip B are designed longer than the remaining n partial channels provided on the respective substrate chips, in order to permit the PCR a longer reaction time for the processes at the inlet and at the outlet of the proposed temperature-zone flow reactor.

At the outlet, here ca4, a not shown photometer unit permits the segmenting of the sample fluid and the use of the miniaturized temperature-zone flow reactor, either by a multiple parallel use of the temperature-zone flow reactor as described in Fig. 1, or by providing, on a respective one of the substrate chips A, B, C, a plurality of closed flow paths subdivided into three zones according to the invention for the transfer and parallel delivery of the samples, as above described.

Fig. 2 exemplifies the signal of such a photometer at the outlet of the miniaturized temperature-zone flow reactor, which makes clear that there is no mixing of the single sample ranges during the flow passage, provided that a liquid non-mixable with the sample, in particular oil, is used as a carrier medium for the sample transport. In the example, a dyed sample was used for testing.

CLAIMS

1. Miniaturized temperature-zone flow reactor comprising at least one multifold wound flow path, formed in a plane substrate by microstructurized channels, characterized in that each of said flow paths constituting a closed flow path is subdivided into at least three partial paths (A1...An; B1...Bn, and BB1...BBn-1; C1...Cn) in such a way that three substrate chips (A; B; C), made of a material of a thermal conductivity as high as possible, are provided, whereby the substrate chips on one of their faces are, at least on those ranges being provided with channels, entirely and level captured by a heating means (H), which permits application of a controllable and variable temperature, and in that
the first substrate chip (A) is provided with inlets (az1), the number of which corresponds to the number of the flow paths present, and that a third substrate chip (C) is provided with outlets (ca4), the number of which corresponds to the number of the flow paths present, and said substrate chips (A;C) are each provided with n channel sections, each of said n channel sections having an inlet opening and an outlet opening (az1...aa4; cz1...ca4) which are arranged on one side substantially along a line side by side on a partial section of the respective substrate chip,
that the first substrate chip (A) and the third substrate chip C being spaced apart from one another are arranged via that surface, which is opposite to the heating means (H), on a first face (V1) of a connecting chip (V), which, being of poor thermal conductivity, is

provided with passage openings (Vd), above said connecting chip (V), and connected to the latter in such a manner that said inlet openings (aa1...aa4) and said outlet openings (cz1...cz4) are captured by said passage openings (Vd), said passage openings (Vd) being connected with one another on the second face (V2) of said connecting chip (V) via microstructurized channels, which form the partial paths (B1...Bn, and BB1...BBn-1) of the second substrate chip (B), whereby one closed flow path each with n passages through the substrate chips (A; B; C) is constituted.

2. Miniaturized temperature-zone flow reactor as claimed in claim 1, characterized in that the respective return channels (BB1...BBn-1) of the partial paths (B1...Bn, and BB1...BBn-1) of the second substrate chip (B) are given a reduced flow cross-section compared to the remaining n channels (B1...Bn) in such a way, that the speed of passage flow through the return channels (BB1...BBn-1) is at least increased by the threefold relative to the speed of passage flow through the remaining channels (B1...Bn).

3. Miniaturized temperature-zone flow reactor as claimed in claims 1 and 2, characterized in that the channels formed by the return channels (BB1...BBn-1) are provided with a thermally insulating lining relative to the substrate chip (B).

4. Miniaturized temperature-zone flow reactor as claimed in claim 3, characterized in that the thermally insulating lining is constituted by a polymer.

5. Miniaturized temperature-zone flow reactor as claimed in claims 1 and 2, characterized in that the connecting chip (V) is made of an optically transparent material.

6. Miniaturized temperature-zone flow reactor as claimed in claim 1, characterized in that the first inlet path (az1 to aa1) in the first substrate chip (A) and the last outlet path (cz4 to ca4) in the third substrate chip (B) are designed longer than the remaining n partial channels provided on the respective substrate chips.

7. Miniaturized temperature-zone flow reactor as claimed in claim 1, characterized in that a liquid non-mixable with the sample, in particular oil, is used as a carrier medium for the sample transport.

8. Miniaturized temperature-zone flow reactor as claimed in claim 1, characterized in that the second substrate chip (B) on one side is captured by a level cooling means (K) to generate a reduced temperature compared to the temperature reduced by the remaining substrate chips (A, B).

ABSTRACT

The invention relates to a miniaturized temperature-zone flow reactor, used for thermally controlled biochemical or molecular-biology processes, especially the PCR method. The invention aims to provide a temperature-zone flow reactor which allows for more effective reactions. To this end at least one closed flow path is provided which is divided into three partial paths (A1...An; B1...B n and BB1...BBn-1; C1...Cn) in such a way that three substrate platelets (A; B; C) consisting of a material whose heat conductivity is as high as possible are provided, which have defined channel sections which are at a distance to each other and connected by a connecting chip (V) consisting of a poorly heat-conductive material. The substrate plateless (A; B; C) are maintained at different temperatures by suitable means.

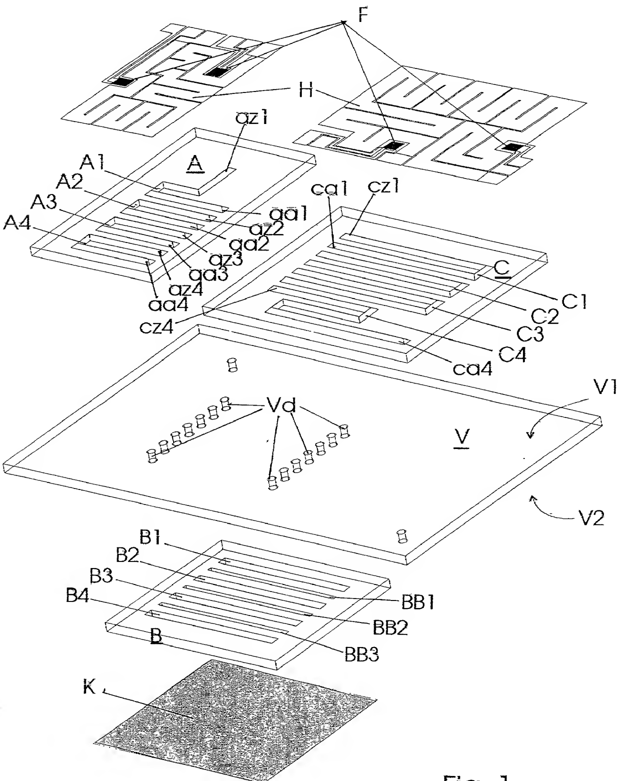
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Fig. 1

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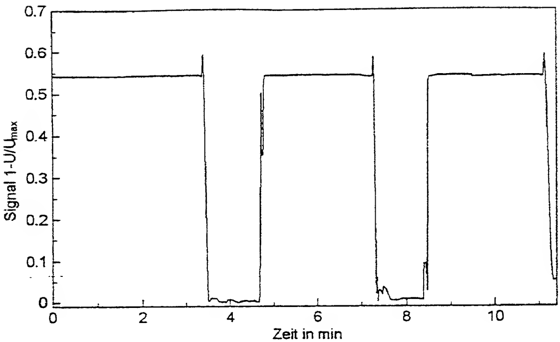

Fig. 2

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	Attorney's Docket Number

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

MINIATURIZED TEMPERATURE-ZONE FLOW REACTOR

the specification of which (check only one item below):

[ ] is attached hereto.

[ ] was filed as United States application
Serial No. ____________
on ____________,
and was amended
on ____________ (if applicable).

[X] was filed as PCT international application
Number PCT/EP99/01014,
on 10.02.1999
and was amended under PCT Article 19
on ____________ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

Country (if PCT indicate "PCT")	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 35 USC 119
DE	198 05 350.9	11.02.1998	[X] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Continued) (Includes Reference to PCT International Applications)	Attorney's Docket Number

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:					
U.S. APPLICATIONS			STATUS (Check One)		
U.S. Application Number	U. S. Filing Date		Patented	Pending	Abandoned
PCT APPLICATIONS DESIGNATING THE U.S.					
PCT Application No.	PCT Filing Date	U.S. Serial Numbers Assigned (if any)			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Frank J. Jordan	Reg. No. ~~20,456~~	Herbert F. Ruschmann	Reg. No. 35,341
C. Bruce Hamburg	Reg. No. 22,389	Marvin Turken	Reg. No. ~~18,330~~
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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